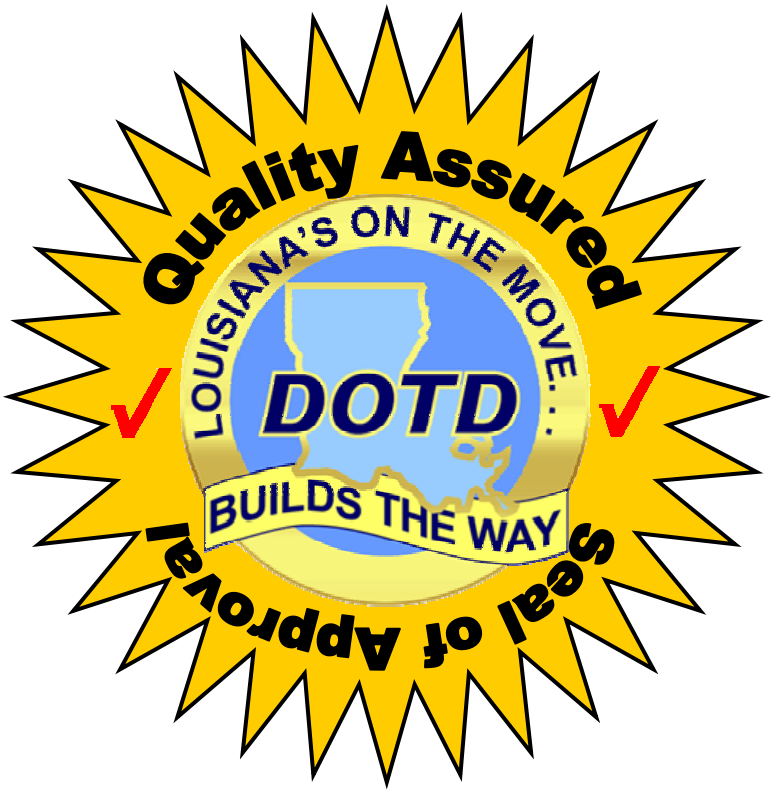
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT



CONSTRUCTION PLANS QUALITY CONTROL / QUALITY ASSURANCE MANUAL

July 2006

TABLE OF CONTENTS

Section 1 - Introduction 3
1.1 Requirements for Quality Control 3
1.2 Objective 4
1.3 Definition of Terms and Abbreviations 5
1.4 Purpose 5
Section 2 - Project Quality Control Requirements 7
2.1 Plans Development Requirements for Review 7
2.2 Conformance to CAD Standards 7
2.3 Plans Reviews 7
2.4 Design Documentation Requirements 8
Section 3 - Organization 9
3.1 Process 9
3.2 Quality Control Responsibilities 9
Section 4 - Quality Control Reviews 12
4.1 Design Review Requirements 12
4.2 General 12
4.3 Phase reviews 13
4.3.1 Review process 13
4.3.2 Review Reports 13
4.3.3 Checking Drawings 13
4.4 Right of Way, Constructability, and Bidability Reviews 14
4.4.1 Right of Way Reviews 14
4.4.2 Constructability Review 14
4.4.3 Bidability Review 14
4.5 Resolution of Disputes 15
Section 5 - Method of Documentation of Comments, Coordination and Responses 16
5.1 Documentation of Comments and Responses 16
5.2 Requests for Changes to the Scope 16
Section 6 - Quality Assurance 17
6.1 General 17
6.2 QA of Consultant Projects 17
6.2.2 DOTD Reviews of Consultant Designs 17
6.3 Feedback 18
References 19

Defining Plan Quality

In an effort to define Plan Quality it is concluded that the following characteristics **(The 5 C's)** would provide an indication of the quality of the plans:

Complete
Consistent
Clear
Correct
Constructible

It is recognized that good communication and significant effort by all "stakeholders" is necessary to meet the 5 C's and achieve the desired result of a quality set of plans.

Section 1 - Introduction

1.1 Requirements for Quality Control

Dictionary definitions for **Quality Control**: the inspection, analysis and action required to ensure quality of output; the operational techniques and the activities used to fulfill and verify requirements of quality; a procedure for keeping quality of inputs or outputs to specifications.

The Quality Control process includes quality planning, training, providing clear decisions and directions, constant supervision, immediate review of completed activities for accuracy and completeness, and documenting all decisions, assumptions and recommendations.

In the construction plan development process, it is the clear responsibility of the designer to ensure all project elements are economical, accurate, properly prepared, coordinated, checked, and completed. In order for the DOTD to consistently meet the needs and expectations of our citizens, quality is as important as the schedule.

All designers and reviewers must recognize that quality is the result of several processes. It requires many individuals performing many appropriate activities at the right time during the plans development process. Quality Control does not solely consist of a review after a product is completed. It is an approach and a realization that quality is something that occurs throughout the design process. Quality requires performing all activities in conformance with valid requirements, no matter how large or small their overall contribution to the design process. Good CAD techniques, attention to detail and ensuring the plans are correct and useful to the contractor are also essential to quality.

Design personnel shall follow established design polices, procedures, standards and guidelines in the preparation and review of all design products.

Design consultants are agents for the DOTD with the primary responsibility for preparation of construction plans. Consultants must ensure quality and adhere to established design policies, procedures, standards and guidelines in the preparation and review of all design products for compliance and good engineering practice as directed by a Project Quality Control Plan.

The Department will review plans for compliance with policies, standards, procedures and good engineering practice but that does not limit the responsibility or liability of the designer. **LADOTD does not check plans.**

The DOTD Project Manager shall monitor the Quality Control efforts used by in-house staff and by consultants.

1.2 Objective

The main objective of the Quality Control process for design projects is to provide a mechanism by which all construction plans can be subject to a systematic and consistent review. The outcome of the review should create a set of quality project plans, which should be substantially error free.

A secondary objective of the Quality Control process is to provide for a well documented "trail" of the design process. A properly documented project file should be a by-product of the quality control process. The Department, as a whole, should be able to substantiate its position from properly documented project files if any legal, social or procedural issues arise regarding the project.

Another secondary objective of the Quality Control process is to provide information feedback from reviews to the designers. The designer's improved expertise and general increase in knowledge from feedback should result in product improvement at early stages even before a project review is started. The Quality Control process thus serves as a parallel training program.

It is not the intent of this manual to supersede the *Roadway Design Procedures and Details Manual* or any other manuals, policies or standards of the Department. This manual is intended to be a living document which will be reviewed and updated periodically to ensure compliance with changes to plans preparation requirements, processes and organizational structure.

1.3 Definition of Terms and Abbreviations

The use of the terms Quality Control, Quality Assurance, and Project Quality Control Plan within this document will be understood to have the following meanings:

Quality Control (QC)
Quality Control is defined as the operational techniques and the activities used to keep the quality of inputs or outputs to specifications; to fulfill and verify requirements of quality.

Quality Assurance (QA)
Quality Assurance refers to those actions, procedures, and methods employed at the management and senior technical levels to observe and see that prudent quality procedures are in place and are being carried out and that the desired result of a quality product is achieved.

Engineer of Record (EOR)
The Engineer of Record is a licensed, professional engineer responsible for the direct control and personal supervision of engineering work.

Phase Review
Phase Review refers to the formal review by various disciplines at various stages of the plans development process. The phase reviews are detailed in the *"Documentation Manual for Project Delivery"* and in the 'Consultant Contracts Services Manual'. Phase reviews typically occur at the 30%, 60%, 90% and plan-in-hand (95%) completion stages for preliminary plans and at the 60% and 90% (ACP) completion stages for final plans.

Project Manager (PM)
The PM is the person responsible for the planning, coordination and controlling of a project from inception to completion, meeting the project's requirements and ensuring completion on time, within cost and to required quality standards.

Quality Assurance Certification
Quality Assurance Certification refers to a signed statement by a management level Engineer certifying that a written, pre-approved Project Quality Control Plan is in place and has been adhered to.

1.4 Purpose

The LA DOTD Plan Quality Control / Quality Assurance Manual is intended to establish a benchmark for effective development of quality control and to assure that quality control has been effectively implemented. The guideline provides coordinated components which will assist project development by identifying:

1) Design considerations which DOTD experience has shown repeatedly require specific attention.

2) Helpful checklists developed by each major discipline for each phase of project development.

3) Sufficiency checklists which enumerate the documents required to be submitted with phase submittals. Completion and submittal with each phase review is the responsibility of the designer.

This manual has been developed by DOTD Design to promote communication among the design sections, various Department review disciplines, the designers, engineering consultants, and Project Managers. The DOTD's interest in preparing this manual is to emphasize the need for a systematic approach to prepare, review and document the plan development process to insure a quality project. The QC/QA process will rely heavily on the *"Documentation Manual for Project Delivery"* which is to be prepared for each project. The *"Documentation Manual for Project Delivery"* contains all of the phase review requirements and checklists and when completed will provide for a well documented project development process.

Section 2 - Project Quality Control Requirements

The methods and processes defined in this manual will serve as the Project Quality Control Plan (PQCP) for each project. Every set of construction plans prepared by or for DOTD are required to follow this process.

The Project Quality Control Plan details the proposed methods or processes of providing quality control for all work products. This plan will be kept current with the work requirements. The plan shall include, but is not limited to, the following areas:

- Organization
- Quality Control Reviews
- Proposed method of documentation of comments, coordination responses and quality assurance records
- Quality Assurance Certification
- Opportunities for Public and Local Government Input

Plans prepared by consultants for DOTD must, at a minimum, follow the procedures set forth in this manual. Consultants may prepare their own Project Quality Control Plan to be submitted to the PM for approval.

2.1 Plans Development Requirements for Review

All phase submittals will be checked prior to presentation to the Department for review. One complete set of review prints with the key sheet signed and dated by the checker, will be submitted to demonstrate that all items were checked. Properly completed QA Checklists for all applicable disciplines will also be submitted. The checklists for each phase review should be appended to the complete set of review prints.

2.2 Conformance to CAD Standards

All plans must meet the CAD/Drafting standards as specified in the engineering contract. Additional CAD standards can be found in the DOTD document, “Automated Plan Production Guide”. DOTD is in the process of developing a formalized CAD standardization process which will ultimately require that all construction plans developed for DOTD be prepared utilizing ‘Microstation’ and ’Inroads’ design software. All plans will have to be certified through a CAD standardization package. This section of this manual will be updated as these requirements are refined and finalized.

2.3 Plans Reviews

In addition to plans checking, the designer will conduct a design review of all documents prior to submitting the documents to the Department. This review shall include, as a minimum, the following activities:

1) Compliance with project requirements.
2) Technical accuracy and adequacy.
3) Compatibility with other associated project documents.
4) Compliance with previous review comments.

The designer will prepare a memorandum documenting the basis of the review, the specific items that were reviewed, the findings of the review, and the follow-up, if any, that was accomplished. Copies of this memorandum will accompany each review submittal.

2.4 Design Documentation Requirements

To facilitate QC reviews of each project, the designer will prepare a written "Project Design Criteria Report" at the onset of the work. A copy of this document will be submitted per requirements of the scope of work for the project and will also serve as the basis for reports, design analyses, and plans preparation.

The *"Documentation Manual for Project Delivery"* will be prepared for each project to document the history of the plans development process and the decisions made during the process.

Section 3 - Organization

3.1 Process

DOTD (and external partners) as a whole must be committed to the QC/QA process to insure a quality product. The reviewing sections and individuals have specific responsibilities as part of the process. Phase reviews are detailed in chapter 4 of this manual and responsibilities of the individuals are described below (Section 3.2).

3.2 Quality Control Responsibilities

The Project Manager is ultimately responsible for each project's adherence to the quality control process. The PM is responsible for reviewing plans for adherence to the scope schedule and budget. The PM is typically responsible for the distribution of review prints at the phase reviews. The PM may review plans for general quality, appearance, accuracy and completeness.

The Designer (Design Consultant or in-house Designer) or the **Engineer of Record** is responsible for accuracy and completeness of the plans and related designs prepared for the project. The designer is responsible for the quality of work of each person involved in the efforts to bring individual projects to production readiness. The designer is responsible for the use of the standardized QC procedures, including all checks, review reports, computations, and other project documentation.

The Road Design Section will review all project plans during the phase reviews for adherence to DOTD design criteria.

The Hydraulics Section will review all project plans during the phase reviews to determine conformance to hydraulic design to DOTD criteria.

The Bridge Design Section is responsible for review of bridge plans and other structural details, such as retaining walls, guardrail standards, sign supports, and barrier rails. This section also has an electrical design unit and a mechanical design unit. The electrical unit will review plan details for electrical systems for buildings, movable bridges, roadway lighting, and overhead signs. The mechanical unit will review plan details of mechanical components, usually in moveable bridges or in building systems.

The District Construction Engineer will review all project plans during the phase reviews to determine constructability and biddability, review areas of possible conflicts and review the adequacy of the Traffic Control Plan. The District Construction Engineer shall evaluate project plans for compliance with applicable elements from the Construction QC Plan to ensure that specific requirements are addressed during design related activities.

The District Maintenance Engineer will review all project plans during the phase reviews to determine maintainability, site-specific existing problems not addressed in the plans and areas of conflict with maintenance operations.

The District Traffic Operations Engineer will review all project plans during the phase reviews to offer advice to the designer related to operational problems concerning the existing traffic control elements, will develop remedial measures for safety related issues and will approve all timing plans for signalization schemes.

The Environmental Section will perform necessary re-evaluations of the documents supporting need for the project and environmental impacts. Commitments made during the environmental process will be documented in the Stage 0 Report. The Environmental Section will insure that all environmental commitments have been addressed, but the Project Manager and the Designer are responsible for addressing all State 0 commitments in the project. The Environmental Section's Federal Permit Coordinator is responsible for obtaining all required federal permits for the projects, such as Corps of Engineers (COE) and Coast Guard permits (among others).

The Pavement and Geotechnical Section is responsible for the development or review of pavement structural designs, embankment stability analyses, settlement analyses and soil foundation design, including deep and shallow foundations and retaining walls. Upon request, this section will obtain subgrade soil borings (deep and/or shallow) for use in these activities. They also obtain the pH and resistivity data for the designer's use in determining gage and coating requirements for metal drainage pipe.

The HQ Construction Section reviews design plans at various stages of plan development, participates in the Plan-in-Hand Inspection as outlined in Section 1.3.2, Step 23 of the *Roadway Design Procedures and Details Manual*, and advises the designer on the acceptability of plan details related to constructability.

The Traffic Engineering Section is responsible for the review and approval of all geometric design, construction signing layouts and traffic striping and marking plans. The section is also responsible for the review of plans for permanent highway signs and traffic signals that are included in roadway plans. These plans may be prepared by in-house forces or by consultants. This section will also review and approve traffic engineering reports prepared by District Traffic Engineers.

The Utility Relocation Engineer and District Utility Specialists are responsible for coordinating with the owners of utilities located within each project to insure that all utility conflicts are addressed prior to construction. These sections review the plans for potential utility conflicts and make recommendations as necessary. As part of this function, they prepare relocation cost estimates and review plans prepared by the utility companies.

The Contracts and Specifications Section prepares the construction proposal. This section reviews plans for conformity to standard bid items and insures the adequacy of the project specifications.

The Location and Survey Section will review and monitor the surveying and mapping work tasks and will review the right-of-way maps in conjunction with the roadway plans to assure agreement between documents.

The Real Estate Section will review the construction plans and right-of-way maps to insure that issues related to right of way acquisition are addressed prior to beginning the acquisition process. This section also prepares real estate estimates for property to be purchased for the project.

The Value Engineering (VE) Office is responsible for the preparation of VE studies on applicable project. This office will also provide direction and support to maintain an active VE program throughout the project's lifespan.

The DOTD Highway Rail Safety Engineer will provide direction and support in developing railroad crossing systems within the plans production and will obtain all applicable railroad agreements, when required.

The Federal Highway Administration (FHWA) will review and approve all plan details at many of the phase reviews for those projects that require federal review.

Section 4 - Quality Control Reviews

4.1 Design Review Requirements

During the entire design period the Department will monitor the designer's implementation of the QC plan and require compliance and documentation.

All major reconstruction projects will be reviewed by the Department at key stages of development. These "Phase" reviews will take place at the plan submittal payment milestones as detailed in the Consultant Contracts Services Manual. These phase reviews include, as a minimum, the 30%, 60% and plan-in-hand (95%) submittal stages for preliminary plans and the 60% and 90% (ACP) submittal for final plans, as outlined in figures 1-7 and 1-8 of the *Roadway Design Procedures and Details* manual, or as modified by the Contract. When required, the Department will review "line and grade" drawings at approximately the 15% complete stage of roadway design development. The purpose of this review is to familiarize the Department with the alignment and profile issues addressed by the design. All intersection and 3-R projects shall be reviewed by the Department at the plan-in-hand and ACP stages at a minimum.

The QA Checklists contained in the *"Documentation Manual for Project Delivery"* provide a list of elements which should be considered and addressed by the designer during each phase of design development. The checklists should not be considered as including all items necessary for a review by discipline, but should be considered as a guide to be expanded or reduced as necessary for each individual project. Design review checklists included in this guideline are intended to assist the designer in preparing an adequate submittal. The sufficiency checklist included in the guideline establishes the submittal requirements which must be met to satisfy the documentation requirements for each project. The designer's attention is directed to the documentation items required for a complete submittal. Missing items can delay or halt a review.

The plans reviewers will check each plan element. If an error is found in a plan element, additional elements will be checked to determine if the procedural error was repeated.

On subsequent submittals, the reviewer will review the disposition of comments from the previous submittal. It is important for the designer to recognize that a review comment is not direction to make plans changes. Comments are frequently made to ensure the designer has considered an option. Responses should indicate the designer's reasoning.

4.2 General

Every product will undergo a quality control review. The reviewer will be an experienced engineer who was not actively involved in the preparation of the product. Checking procedures for these quality control reviews are discussed in Sections below.

Also, note that there is an overlap among reports, calculations and plans. Most reports and calculations are incorporated into the plans. Checks should be made to ensure that calculations/reports are correctly incorporated into the plans.

4.3 Phase reviews

4.3.1 Review process

All projects are required to be reviewed at the phase reviews as noted in Section 4.1. The guidelines and checklists contained in the *"Documentation Manual for Project Delivery"* define those tasks which should be completed by each submittal and those items that will be reviewed. The Plans Distribution list clearly outlines who is to receive and review prints at each phase review. At each submittal stage, the Project Manager will review the submittal for the degree of completeness required by that phase. Plans will be returned to the designer if they are incomplete, which could cause delays to the project's schedule. Plans will be distributed by the Project Manager as detailed on the Plans Distribution list. The Project Manager will provide a date by which all comments are to be received by the PM. It is the responsibility of each reviewer to review the plans in accordance with their area of expertise and return their comments to the PM by the date specified. Any breakdown in the review process or untimely comments can result in plan errors, delays and increased project costs.

4.3.2 Review Reports

Comments from phase reviews can be in the form of marked-up plans, meeting minutes (as in a plan in hand review meeting) or review memoranda. It is the responsibility of each reviewer to insure that their comments are submitted to and recorded with the Project Manager. It is the Project Manager's responsibility to compile comments, document the comments and distribute the comments to the designer and others if necessary. It is then the designer's responsibility, in consultation with the Project Manager, to review the comments and to determine how each comment will be addressed. The designer will prepare a formal response to the PM stating how the comment will be addressed. The Project Manager will forward these responses to the appropriate reviewer and will insure that all comments and responses have been documented in the project files. It is the designer's responsibility to insure that all comments are incorporated into the construction plans.

4.3.3 Checking Drawings

Drawings are prepared under the direction of an assigned designer. They are developed progressively by an interactive process using sources of information such as survey data, reports, record data, preliminary sketches, samples, official maps, etc, in conformance with the requirements, design criteria, and standards and guidelines required by DOTD. Before a drawing is considered final, it will be independently checked for (notice the 5 C's):

- Conformance with the design criteria and project requirements (scope), including graphic standards (CADD Standards), compatibility standards and good plans preparation practice (Correct and Consistent)
- Completeness and clarity
- Coordination with other aspects of the project, i.e., structural, civil, traffic, right-of-way, etc., and with other associated project documents (Constructable)
- Coordination with project elements being developed or planned development on adjacent projects

4.4 Right of Way, Constructability, and Bidability Reviews

4.4.1 Right of Way Reviews

A right of way review meeting, also known as the Joint Plan Review Meeting, is scheduled and conducted by the Real Estate Section. This review takes place at the 60% complete R/W map stage and roughly corresponds with the plan-in-hand stage of construction plan development. The purpose of this review is to allow input from the invited sections to assist the Right of Way Section in reducing right of way costs and to insure that issues raised by the Real Estate Section are addressed in the construction plans. The R/W maps are also reviewed for conformance with the construction plans.

4.4.2 Constructability Review

The constructability review occurs at the 60% preliminary plans phase. Plans are sent to the District Construction Engineer to provide the constructability review.

Too often, work that is to be performed during construction is primarily defined by the designer emphasizing a designer's perspective, without adequately addressing the actual "build-ability" of the project. The constructability review during the design phase is intended to save on project costs, anticipate and mitigate field problems, minimize potential change orders, improve the overall project timeline, and still achieve the designer's intent. Some of the items to be considered include scheduling requirements, sequencing, phase conflicts, completeness and clarity, errors, omissions, inconsistencies, change order potential, construction means, construction methods, contracting strategy, construction materials fabrication requirements.

4.4.3 Bidability Review

Bidability reviews shall be done on every project. These reviews shall be done as part of the final plans processing and is initiated by the Project Manager, typically as part of the ACP phase review. The purpose of this review is to discuss and develop strategies that will facilitate clear and competitive bids and yield lower bid prices. The bidability review should help to avoid claims since a well thought-out bid schedule leaves fewer obstacles to resolution

4.5 Resolution of Disputes

During the review and checking process, if the designer does not agree with the review comments, he will first discuss the matter with the Project Manager. The Project Manager may also have some disagreements with the comments. The Project Manager will discuss the comments with the reviewer to achieve a resolution. Likewise, if a reviewer is in disagreement with a response to a comment, the reviewer will discuss the issue with the Project Manager. If the difference cannot be resolved between the Project Manager and the reviewer, the Project Development Division Chief will be consulted to assist in the resolution of the dispute.

Section 5 - Method of Documentation of Comments, Coordination and Responses

5.1 Documentation of Comments and Responses

All comments made by phase reviewers shall be recorded either by copy of memos, e-mail, letters and/or marked plans received from the reviewers. In the event that comments are received through meetings with reviewers, there shall be minutes prepared that summarize the comments received. All comments shall be addressed by the designer responsible for the discipline that prepared the document being reviewed. The response shall be in writing and shall be formatted in a manner that identifies the document review date, reviewer's comments and responses to the comments. All comments received shall be copied to the EOR if not first received by the EOR. All comment/response drafts shall be submitted to the EOR for his review. The EOR will be responsible for submittal of comment/responses to the reviewing entity.

Where it is necessary and prudent to discuss the comments with the reviewer(s) prior to making a response, the EOR shall arrange for the meeting.

Copies of all comments and responses shall be kept in the project files.

5.2 Requests for Changes to the Scope

The PM and EOR shall evaluate comments or requests that are not covered in the "Final Project Scope." Additions to the scope usually increase the project costs (a.k.a., Scope Creep). These requests should be evaluated on a case by case basis and ultimate approval/denial should be made by the Chief Engineer or his designee.

Section 6 - Quality Assurance

6.1 General

QA does not include only periodic reviews to ensure compliance with the QC process but also includes review of several other established processes. The Project Manager shall ensure that appropriate levels of review (and cooperativeness in the review process) have occurred for:

- Constructabilty
- Bidability
- Value Engineering
- Project Documentation

QA also incorporates a general review of personnel to ensure an acceptable level of expertise is maintained for quality design products. All Design personnel shall be advised of the details of the QC plan.

Communication is also a vital element in all processes. QA includes the review of the level and quality of communications and documentation accomplished during the various processes.

6.2 QA of Consultant Projects

Consultant projects shall undergo the same QA review as in-house projects. Consultant Project Quality Control Plans shall be submitted to the DOTD Project Manager in advance of any design work and shall include but not be limited to the following areas:

- Organization
- Quality Control Review of Plans, Reports, Calculations & Correspondence
- Proposed Method of Documentation of Comments, Coordination, Response and QA Records
- Control of Sub-Consultants and Vendors
- Efficiency
- Quality Assurance Certification
- Public and Local Government Input

All submittals shall also be subject to quality assurance audits by DOTD. Problem areas shall be discussed with the consultant and agreed upon remedial actions shall be taken by the consultant prior to any further payment of consultant invoices.

6.2.2 DOTD Reviews of Consultant Designs

Projects in DOTD's work program are identified for various levels of review by DOTD. Where any review by DOTD is performed, consultants must not rely on DOTD as a part of their QC plan

either formally or informally. Consultants are expected to follow their own QC plans and accepted engineering practices.

6.3 Feedback

The Project Engineer for each construction project is required to prepare a 'post-construction' checklist to provide feedback as to the quality and accuracy of the construction plans. This feedback is to be provided to the Project Manager to serve as 'lessons learned' to the designer and to be considered in the final rating for consultant designed plans. These checklists will be compiled and categorized and distributed to all of the various design sections to serve as a knowledge base to improve the quality of construction plans.

The Construction Division should schedule a semiannual Construction Feedback Meeting with the Design Sections. At this meeting, the Construction section should provide technical presentations to the designers for updates on construction and production issues as it relates to plan preparation and constructability improvements.

References

Checklists (included in the *"Documentation Manual for Project Delivery")*

- Check List for Pre-Design 10/31/2005
- Pre-Design Conference Evaluation 3/27/03
- Plan In Hand Check List 10/31/2005
- Check List of Proposed Construction Notes for Plan in Hand 10/31/2005
- Plan In Hand Review 11/01/2001
- Check List for Reviewing Advanced Check Prints 10/31/2005
- Constructability Review 03/01/2001

Requirements for Plan Review (included in the *"Documentation Manual for Project Delivery")*

- Minimum requirements for preliminary geometric review
- Requirements for hydraulic review (memo 1/23/01)

Plans Distribution List

Plan Payment Milestones (included in the *"Consultant Contract Services Manual"*)